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THE EFFICIENCY OF SELECTION FOR LINT INDEX AND THE OTHER TRAITS IN SOME COTTON VARIETIES

Zeina, A.M. and M.A. Abd El-Gelil
Agricultural Research Center, Cotton Research Institute

ABSTRACT

The present investigation was carried out at Sakha Agriculture Research Station, during the three successive seasons of 1999, 2000 and 2001. Six varieties of cotton were used in this study. These varieties were: Giza 70, Giza 88, Giza 76, Giza 86 (An Egyptian varieties), Karshenseky-2 "Kar. 2" (Russian variety) and Pima S6 (An American Egyptian variety).

Selection for increasing lint index and its indirect effect were studied on backcrosses and F_2 generations of some cotton varieties (Giza 70, Giza 88, Giza 76, Giza 86, Karshenseky-2 and Pima S6). A selection intensity of 5% was used with direct selection. The mean squares from the analysis of variance were significant for genotypes and parents for most studied traits. Crosses and parents virsus crosses mean squares were significant for seed cotton yield/plant, lint yield/plant and fiber length and insignificant for all studied traits, respectively. Positive direction in F_2 was accompanied by significant increases of lint percentage in G 70 x Karshenseky-2, G. 88 x Pima S6 and G. 76 x Karshenseky-2, while it was insignificant for boll weight and seed index in most F_2 crosses. Backcrosses showed insignificant increases for most traits. The negative direction in backcrosses revealed insignificant decreases for all studied traits in most crosses, while, F_2 populations illustrated significant decreases for lint percentage in most crosses and it was insignificant for boll weight, seed index and some fiber traits. Most backcrosses and F_2 populations had considerable amounts of the actual genetic gain for lint index, lint percentage, seed index, boll weight, in G 70 x Karshenseky-2, G. 88 x Pima S6 and G. 76 x Karshenseky-2, for seed cotton yield and lint/plant and in G. 70 x Karshenseky-2 for most fiber traits in backcrosses only.

No differences between the predicted and the actual genetic gains more observed for lint index on one side and pressley index, 50% span length and 2.5% span length on the other side as indirect effect of selection, indicating an independent inheritance of lint index.

INTRODUCTION

The ultimate goal of a cotton breeding is to increase the yielding capacity. Therefore, direct selection for lint index is commonly used by plant breeders to improve lint yield in cotton. Indirect selection would be superior for choosing lines that posses high lint yielding capacity. Progress by selection could be determined by the genetic variability of the traits concerned, the intensity of selection which could be achieved, and the accuracy of this selection. Plant breeders are constantly faced with the problem of identifying true superior breeding material due to the masking of heritable by non-heritable variation. Subjective evaluation often leads to less than maximum gains. Numerous cotton researchers reported that lint yield is the most important economic trait in cotton and concluded that the number of boll per plant, boll weight and lint index had the most influence on lint yield among

1974; Zeina, 1981, Abou El-Yazied, 1999 and Abdel-Hafez *et al.*, 2000 who found significant and insignificant correlations for these traits in Egyptian cotton varieties, Shafshak *et al.*, 1987, in American cotton varieties, and Abou-Tour *et al.*, 1996 showed the presence of insignificant positive correlation between yield and most its components traits. Abo-Arab, 1998, reported that increased lint index was associated with decreased seeds/boll in F_2 and backcrosses.

This investigation was carried out to determine the efficiency of selection for lint index and its indirect effect on the other related traits.

MATERIALS AND METHODS

The present investigation was carried out at Sakha Agriculture Research Station, during the three successive seasons of 1999, 2000 and 2001. Six varieties of cotton namely; Giza 70, Giza 88, Giza 76, Giza 86 (Egyptian cotton), Karshenseky-2 "Kar. 2" (Russian variety) cotton and Pima S6 (American Egyptian variety) were used in this study. Four crosses were studied included; (G. 70 x Kar. 2), (G. 88 x Pima S6), (G. 76 x Kar. 2) and (G. 86 x Kar. 2). Their segregating generations were developed in the 2000 growing season. In 2001 all genotypes were evaluated in a randomized complete blocks design with three replications. Each replicate contained of twenty eight rows for; the six populations, ten the F_2's, six BC_1 and BC_2 and two for any non segregation populations (P_1, P_2 and P1's) . Each row was 4.5 meters long and comprised twelve hills, each of one plant. Data were recorded for seed cotton yield/plant, lint yield/plant, lint percentage, boll weight, seed index, lint index, micronaire reading, pressley index, 50% and 2.5% Span length and uniformity ratio.

Selection efficiency was estimated in F_2 populations using the following formula (Becker, 1975).

Predicted genetic gain = $K.\ h^2_{(n)}\ \sigma P$.

Where

K is the standardized selection differential (at 5% selection intensity and equal to 2.06).

$h^2_{(n)}$ = The narrow sense heritability.

σp = The phenotypic standard deviation of F_2 generation.

The narrow sense heritability was estimated by using the following formula (Cochran and Cox, 1957).

$$h^2(n) = \frac{2\ VF2\ -\ (VBc_1\ +\ VBc_2)}{VF_2} \times 100$$

Where:

VF_2 = The phenotypic variance of the F_2 generation.

VBc_1 and BVc_2 = The phenotypic variance of two backcrosses

The actual genetic gain was also calculated as the following equation adapted by Becker (1975).

Actual genetic gain = $\overline{X}p - \overline{X}o$

Where:

$\overline{X}p$ = The mean of selected F_2 or backcross plants (positive direction) at 5% selection intensity.
$\overline{X}o$ = The mean of F_2 or backcross (over the two backcrosses for each cross) population.

RESULTS AND DISCUSSION

The analysis of variance in Table 1 showed insignificance for genotypes mean squares for seed index and pressley index. These results might due to high values of its pooled error, or similar in genetic background while, showed significance or highly significance mean squares for lint index, seed cotton yield, lint yield, lint percentage, boll weight, micronaire reading, 50% span length, 2.5% span length and uniformity ratio. These results confirmed the presence of genetic variabilities in these genotypes for these traits.

Partioning of genotypes mean squares to its three components; i.e., parents, crosses and parents versus crosses, showed highly significant differences for seed cotton yield/plant, lint yield/plant and lint percentage for parents which must carry genes with different additive effects, while crosses mean squares were insignificant for all traits except for seed cotton yield/plant, lint yield/plant and 2.5% span length. Also, heterosis overall crosses was insignificant mean squares for all studied traits.

Positive direction of selection in F_2 was accompanied by significant increasing for lint percentage in G.70 x Kar. 2, G. 88 x Pima S6 and G. 76 x Kar. 2 crosses and insignificant increases for boll weight and seed index in most crosses. While, it showed insignificant increases for most traits in all back crosses. Kittock and Pinkas (1975) in Pima cotton, reported that the increased lint per seed was associated with decreased mean seed weight and an increase in number of seeds/boll. El-Kilany (1976) found a significant negative genotypically association between lint per seed and seed per boll in F_2 and F_3 generations. El-Okkia (1979) found that a weak negative and inconsistent phenotypic and genotypic associations between lint yield per plant and number of seeds per boll over three studied generations. On the other hand, lint per seed was the most effective yield contributing character and showed that seed per boll was negatively associated with lint per seed. Abo-Arab (1998) reported that the increased lint index was associated with decreased seed per boll in F_2 and back crosses.

Concerning, selection in the negative direction in backcrosses revealed insignificant decreases for all studied traits in most crosses while, F_2 populations illustrated significant decreases for lint percentage in most crosses and insignificant decreases for boll weight, seed index and pressley index, 2.5% span length, uniformity ratio in some crosses.

Knowledge concerning the association between traits is of a prime importance to the breeders as it broadens the perspective which could manipulate indirect selection for two or more traits simultaneously. This association may be either harmful or beneficial, depending upon the direction of the genetic correlation and the objectives of the breeders.

Table 1:Mean squares of all studied characters in F_1.

Character S.O.V.	d.F	LI	S.C.Y.	L.Y.	B. W	L%	S.I	Mic	Press. I	50% S.L.	2.5% S.L.	U.F.%
Reps.	2	0.0512	31.276	13.536	6.4461	0.0725	0.1761	0.0233	0.8258	0.0338	0.2758	0.1075
Genotypes	9	0.6016**	1540.351**	216.464*	16.7089**	0.0971**	0.2152	0.4171*	0.1613	3.6030*	13.4136*	2.7463*
Parents	5	0.7802*	1804.696**	278.467**	20.3583**	0.1196*	0.2108	0.5889*	0.2232	3.6516*	15.2926*	2.7606
Error 1	10	0.1806	50.904	6.4191	2.0612	0.0217	0.4640	0.0562	0.4068	0.8032	3.0179	1.4499
Crosses	3	0.1512	1531.945**	209.608**	6.55083	0.0676	0.2142	0.1764	0.1053	4.6542*	14.5211**	3.5878*
Error 2	6	0.1920	43.764	5.832	6.0285	0.0227	0.1614	0.0656	1.4503	0.1992	0.3803	0.2353
P.V.C.	1	1.0598	243.912	72.991	28.9362	0.0737	0.2402	0.2801	0.0200	0.2066	0.6969	0.1505
Residual	2	0.0195	230.428	7.902	0.6938	0.0512	0.0047	0.0028	2.0057	0.9183	2.2464	0.3929
Pooled error	18	0.1665	68.471	6.386	3.2317	0.0253	0.3121	0.0534	0.9323	0.6147	2.0530	0.9276

1) L.I. = Lint index 2) S.C.Y. = Seed cotton yield/plant
3) L.Y. = Lint yield/plant 4) B.W = Boll weight
5) L.% = Lint percentage 6) S.I. = Seed index
7) Mic. = Micronaire reading 8) Press. I = Pressley index
9) 50% S.L. = 50% Span length 10) 2.5% S.L. span length
11) U.F. %= Uniformity ratio

Table 2 shows positive associated between lint index and most studied traits in most backcrosses and F_2 generations, suggesting that selection for the improvement of any one trait would automatically improve the other. While, the independent relationship indicated that selection could be practiced for both traits at the same time without any reduction in the other, such as noticed between lint index and fiber traits, micronaire reading, strength, length at 50% and 2.5% and uniformity ratio. Zeina (1981), found significant or insignificant positive correlation between lint index on one side and lint yield, lint percentage, boll weight and seed index on the other side in ten Egyptian cotton varieties. Also, Shafshak *et al.* (1987) showed the same results in six Egyptian and American cotton varieties and Abou-Tour *et al.* (1996) found insignificant positive correlation between the same traits. The results obtained by many investigators such as Allam (1997), Abou El-Yazied (1999) and Abdel-Hafez *et al.* (2000) were in general agreement with the present results.

Table 2: Direct effect of selection for high and low lint index and its indirect effect on the other traits.

Characters / Generation			L.I.	S.C.Y	L.Y.	B.W.	L%	S.I	Mic.	Pess. I	50% SL	2.5% SL	U.F. %
C_1	Bc.	Pop.	3.90	67.10	22.22	2.52	33.05	7.89	3.0	10.2	15.9	31.6	48.9
		+d	4.62	82.71	28.34	2.66	34.73	8.70	3.2	10.5	16.9	33.5	50.4
		-d	3.13	53.81	16.60	2.35	30.57	7.18	3.0	10.0	15.7	31.2	47.7
	F_2	Pop.	3.88	82.54	25.30	2.43	30.77	8.55	3.4	10.3	16.2	31.9	50.7
		+d	5.31**	75.76	26.75	2.60	35.28**	9.74	3.5	10.9	16.1	31.7	50.3
		-d	2.68**	82.37	22.75	2.36	27.46**	7.12	3.6	10.2	16.3	32.2	51.1
C_2	Bc.	Pop.	3.59	84.88	27.94	2.39	31.12	7.93	3.4	9.7	15.6	31.0	49.7
		+d	4.0	90.46	33.01	2.51	32.17	8.45	3.6	9.7	15.2	30.6	49.7
		-d	3.02	85.68	25.43	2.23	29.68	7.46	3.3	9.6	15.7	31.0	49.2
	F_2	Pop.	3.68	77.19	26.44	2.59	31.27	9.45	3.4	9.8	15.6	31.0	49.8
		+d	4.52**	71.95	24.13	2.52	33.56**	8.97	3.6	9.2	15.5	30.9	50.03
		-d	3.10*	80.29	23.21	2.31*	29.09*	7.62	3.4	9.9	15.6	31.2	49.6
C_3	Bc.	Pop.	4.07	86.50	28.06	2.45	32.10	8.57	3.3	9.8	15.6	30.5	51.1
		+d	4.61	106.24	35.81	2.52	33.81	9.02	3.5	9.6	15.5	30.2	51.2
		-d	3.56	69.97	21.45	2.34	30.77	7.97	3.2	10.0	15.7	30.5	51.4
	F_2	Pop.	4.35	66.21	22.88	2.57	34.74	8.17	3.2	9.8	15.1	30.6	49.5
		+d	4.98*	58.73	21.80	2.49	37.09*	8.46	3.3	10.0	15.2	30.9	49.1
		-d	3.64**	66.88	21.49	2.40	32.04**	7.73	3.1	9.7	15.0	30.2	49.8
C_4	Bc.	Pop.	4.48	87.04	28.15	2.55	32.33	8.54	3.9	9.9	15.4	31.7	50.7
		+d	4.66	86.92	28.25	2.65	32.47	9.13	3.8	10.3	16.3	31.6	50.3
		-d	4.30	87.00	27.80	2.50	31.95	8.20	4.0	9.2	14.7	32.0	51.06
	F_2	Pop.	4.44	87.91	29.41	2.65	33.50	8.64	3.8	10.1	16.2	32.4	49.8
		+d	4.83	84.71	29.79	2.73	35.21	8.89	4.0	9.9	15.8	32.5	50.0
		-d	4.18	88.15	28.49	2.72	32.29	8.76	3.8	10.14	16.3	.5	50.3
L.S.D.	0.05 F_2		0.430	26.41	7.20	0.240	1.770		0.384		2.698	9.981	1.395
	0.01 F_2		0.650	39.99	10.78	0.358	2.680		0.593		4.088	14.861	2.113
L.S.D.	0.05 Bc		25.690	8.55	-	-	-	-	-	-	2.698	2.229	2.567
	0.01Bc		38.88	12.94	-	-	-	-	-	-	4.088	3.377	3.892

C_1 = G. 70 x Kar.-2, C_2 = G. 88 x Pima S6, C_3 = G. 76 x Kar.-2, C_4 = G. 86 x Kar.-2

The predicted genetic gains at 5% selection intensity, as well as the actual genetic gain in F_2 and backcrosses populations are shown in Table 3. Most crosses irrespective backcrosses or F_2 populations had considerable amounts of actual genetic gain for lint index, lint percentage, seed index, boll weight, in G. 70 x Kar. 2, G. 88 x Pima S6 and G. 76 x Kar. 2 for seed cotton yield and lint yield/plant and in G. 70 x Kar. 2 hybrid for most fiber traits in backcrosses only. These results indicated the possibility of increasing lint percentage, seed index, boll weight seed cotton yield and lint yield by increasing lint index. The other traits revealed negative values of the actual genetic gain in backcrosses and F_2 populations. While, the predicted genetic gains were low for lint index and lint percentage in some crosses, this result may be due to the low phenotypic variance for these traits and high for remaining traits compared with the actual genetic gains in F_2 generations. Miller and Rawlings (1967) reported that there was generally close agreement between predicted and observed responses to selection. Penny and Eberhart (1971) indicated that the discrepancy between the expected and the observed gain might be due to either overestimation of additive genetic variance or the lack of precision in the method of individual plant selection.

Table 3: Predicted and actual genetic gains for lint index and its effect on the corresponding predicted and actual gains of another studied characters in backcrosses and F_2 generations.

Gener.		L.I.	S.C.Y	L.Y.	B.W.	L%	S.I	Mic.	Pess. I	50% SL	2.5% SL	U.F. %
C_1	Actu BC	0.72	15.61	6.12	0.14	1.68	0.81	0.20	0.3	1.00	1.90	1.50
	Actu. F_2	1.43	-6.78	1.45	0.17	4.51	1.19	0.10	0.60	-0.10	-0.20	-0.40
	Pred. F_2	1.61	77.68	19.98	0.28	3.09	1.88	0.21	1.06	0.09	1.18	1.50
C_2	Actu BC	0.41	5.58	5.07	0.12	1.05	0.52	0.20	0.00	-0.4	0.4	0.00
	Actu. F_2	0.84	-5.24	-2.31	-0.07	2.29	-0.48	0.20	-0.6	-0.1	-0.1	0.23
	Pred. F_2	0.55	44.05	13.2	0.64	2.35	1.29	0.01	0.27	0.56	0.73	1.26
C_3	Actu BC	0.54	19.74	7.75	0.07	1.71	0.45	0.2	-0.2	-0.1	-0.3	0.1
	Actu. F_2	0.63	-7.48	-1.08	-0.08	2.35	0.29	0.1	0.2	0.1	0.3	-0.4
	Pred. F_2	0.34	23.29	4.00	0.9	1.76	0.30	0.39	0.59	0.86	1.94	1.39
C_4	Actu BC	0.18	-0.12	0.10	0.10	0.14	0.59	-0.1	0.40	0.90	-0.1	-0.4
	Actu. F_2	0.39	-3.2	0.38	0.08	1.71	0.25	0.20	-0.2	-0.4	0.1	0.2
	Pred. F_2	1.57	1.71	0.52	1.68	1.55	0.40	0.94	0.52	0.06	0.07	0.15

BC = Backcrosses.

No differences between the predicted and the actual genetic gains more observed for lint index on one side and some fiber traits, such as pressley index, 50% span length and 2.5% span length on the other side as indirect effect of selection, indicating the independent inheritance of lint index.

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الأنتخاب لمعامل الشعر العالى وتأثيره على الصفات الأخرى فى بعض اصناف القطن

عبدالمعطى محمد زينه و محمد عبدالباقى عبدالجليل
معهد بحوث القطن ـ مركز البحوث الزراعية

تهدف الدراسة التى أجريت خلال ثلاث مواسم نمو ١٩٩٩-٢٠٠١م بمحطة البحوث الزراعية بسخا إلى معرفة تأثير الأنتخاب المباشر لمعامل الشعر العالى وتأثيره على الصفات الأخرى فى كلا من فى الأجيال الرجعية والجيل الثانى.

واتضح من النتائج ما يلى:

- صاحب زيادة معامل الشعر زيادة معنوية لصفة معدل الحليج فى الهجن جـ٧٠ × كارشنسكى ، جـ٨٨ × بيما S6 ، جـ٧٦ × كارشنشكى وزيادة غير معنوية لصفتى وزن اللوزة ومعامل البذرة فى معظم الهجن فى الجيل الثانى وزيادة غير معنوية لمعظم الصفات المدروسة فى الهجن الرجعية.
- أظهر الأنتخاب لمعامل الشعر المنخفض نقص غير معنوى لكل الصفات المدروسة فى معظم الهجن الرجعية ونقص معنوى لتصافى الحليج وغير معنوى لصفة وزن اللوزة ومعامل البذرة والمتانة والطول عند ٢,٥% ونسبة الانتظام فى بعض الهجن فى الجيل الثانى.
- كان التحسن الحقيقى ملموسا فى معظم الأجيال الرجعية والجيل الثانى لصفات معامل الشعر وتصافى الحليج ومعامل البذرة ووزن اللوزة. وأظهرت الهجن جـ٧٠ × كارشنسكى ، جـ٨٨ × بيما S6 ، جـ٧٦ × كارشنسكى تحسنا فى صفتى محصول القطن الزهر والشعر للنبات والهجين جـ٧٠ × كارشنسكى فى معظم صفات التيلة المدروسة فى الأجيال الرجعية فقط.
- لم تظهر اختلافات بين التحسن المتوقع والحقيقى لصفة معامل الشعر من جهة وصفات المتانة والطول عند ٥٠% ، الطول عند ٢,٥% من جهة أخرى كتأثير غير مباشر للأنتخاب. مما يؤكد استقلالية وراثة صفة معامل الشعر عن هذه الصفات.